

## A NEW CHINESE EYED TURTLE OF THE GENUS *SACALIA* (BATAGURINAE: TESTUDINES)

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*Abstract.*—A new species of batagurine turtle, *Sacalia pseudocellata*, is described from Hainan Island, China. Similar to and apparently sympatric with *Sacalia quadriocellata*, it differs from that species and *S. bealei* by having eye-like markings without “pupils” on the posterolateral aspect of the head, a slightly tricarinate (generally unicarinate in *S. bealei* and *S. quadriocellata*) and wider carapace, more extensive black plastral pigment, a more extensive plastron, longer and narrower gular scutes, and a shorter interfemoral seam.

*Cistuda bealei* (the four-eyed turtle) was first described in 1831 by John Edward Gray from “China,” and it is known to range from southeastern China to at least central Vietnam (Buskirk 1989, Iverson 1992). Although it has been placed in four different genera by various authors, it was finally returned to Gray’s (1870) monotypic genus *Sacalia* based on biochemical (Merkle 1975) and morphological studies (McDowell 1964).

In 1903 Siebenrock described the western geographic variant of *Sacalia* (then *Clemmys*) *bealei* as *C. b. quadriocellata*. This form was considered a separate species by a few early authors (e.g., Pope 1935, Bourret 1941); however, Sachsse (1975), Rödel (1985), and Rödel & Praedicow (1988) argued that *quadriocellata* is conspecific with *bealei*. Recently, Fu & Zhao (1989) presented morphometric and color pattern data that supported the recognition of *bealei* and *quadriocellata* as distinct species.

Three-“eyed” turtles from Hainan Island represent an undescribed species and they show more similarity with *Sacalia bealei* and with *S. quadriocellata* (with which it is apparently sympatric) than with any other Chinese batagurine turtles. This distinctive species is tentatively referred to the genus *Sacalia*, although confirmation of this assignment must await the availability of osteological material.

*Sacalia pseudocellata*, new species  
Chinese false-eyed turtle  
Fig. 1A–D

*Holotype.*—UF 81505, an adult male, preserved in alcohol; reported to have been collected between Tungfang [19°03'N, 108°56'E] and Kancheng [18°51'N, 108°37'E; ca. 48 km from Tungfang], western Hainan Island, China; purchased from local persons living between those cities by Mr. Oscar Shiu, in the spring of 1988.

*Paratype.*—UF 81506, an adult female, preserved in alcohol; same data as holotype, except purchased in the spring of 1990.

*Diagnosis.*—A medium-sized species of *Sacalia* (Fig. 1A–D, Table 1) with black-bordered yellow to olive-green blotches dorsolaterally on head region, a weakly tricarinate carapace (generally unicarinate in other *Sacalia*; e.g., *S. bealei* and *S. quadriocellata*), a carapace of medium width (relatively narrow in other *Sacalia*), heavily pigmented plastron (lightly pigmented in other *Sacalia*), a relatively long, broad plastron (shorter and narrower in other *Sacalia*), a relatively long, narrow gular scute (shorter and wider in other *Sacalia*), a relatively long interpectoral seam (shorter in other *Sacalia*), and a relatively short interfemoral seam (shorter in other *Sacalia*).

*Description* (based on the types, and a living juvenile female).—Carapace length (CL)



Fig. 1. Adult female *Sacalia pseudocellata* (A–D; paratype: UF 81506; 176 mm carapace length) from Hainan Island, China; typical head patterns of male (left) and female (right) *Sacalia bealei* (E, F) and *S. quadriocellata* (G, H).

Table 1.—Morphometric characters useful in discriminating among species of the genus *Sacalia*. Character abbreviations are interhumeral seam length (IH), interpectoral seam length (IP), interfemoral seam length (IF), maximum gular scute length (GL), maximum gular scute width (GW), maximum carapace width (MCW), and anterior width of plastral hindlobe (PW3).

Sample	Sex	<i>n</i>	Carapace length (mm)	IH/IP	IF/PW3
<i>S. pseudocellata</i>	M	1	151.8	0.434	0.248
	F	2	147.8 (119–176)	0.255 (0.24–0.27)	0.255 (0.24–0.27)
<i>S. bealei</i>	M	5	127.2 (114–136)	0.609 (0.54–0.68)	0.310 (0.29–0.35)
	F	4	132.0 (119–140)	0.521 (0.42–0.69)	0.321 (0.29–0.38)
<i>S. quadriocellata</i>	M	4	127.0 (120–143)	0.677 (0.53–0.82)	0.339 (0.27–0.44)
	F	4	130.6 (127–139)	0.596 (0.48–0.70)	0.339 (0.29–0.38)

to at least 152 mm in males and at least 176 mm in females; carapace elliptical, weakly tricarinate (shell height at level of hinge/carapace length =  $CH/CL = 0.36$  to  $0.39$ ;  $\bar{X} = 0.375$ ), widest at level of marginal M7 (maximum carapace width:  $MCW/CL = 0.69$  to  $0.75$ ;  $\bar{X} = 0.721$ ), with a smooth to slightly serrated posterior margin, and with moderately obvious growth laminae.

M1, M7, M8, or M9 widest, M11 narrowest, and M9 tallest. Cervical scute small, basically rectangular (but widest posteriorly), and longer than wide. All vertebrals (V) wider than long; V1 contacting (or nearly so) seam between M1 and M2; V5 not contacting M10. Low medial keel most pronounced on V1, V4 and V5. Carapace dark to rusty brown, with tiny black flecks and streaks anteriorly.

Maximum plastron length shorter than carapace length ( $PL/CL = 0.93$  to  $0.95$ ), slightly upturned anteriorly, with no hinge between pectoral and abdominal scutes. Anterior plastral lobe shorter than posterior lobe. Plastral forelobe width (across level of junction of humero-pectoral seam and lateral plastral margin) relatively wide ( $PW1/CL = 0.44$  to  $0.45$ ;  $\bar{X} = 0.445$ ). Plastral hindlobe width (at lateral junction of abdominal-femoral seam) relatively wide ( $PW3/CL = 0.51$  to  $0.53$ ;  $\bar{X} = 0.518$ ). Plastral hindlobe with shallow anal notch. Bridge moderately long ( $BL/CL = 0.35$  to  $0.37$ ;  $\bar{X} = 0.355$ ); a single small axillary and inguinal

scute on each side of bridge. Average plastral formula: interpectoral seam (IP)  $\geq$  interabdominal seam (IAB)  $>$  interanal seam (IAN)  $\gg$  intergular seam (IG)  $>$  interfemoral seam (IF)  $\gg$  interhumeral seam (IH).  $IG/IAB = 0.53$  to  $0.67$  ( $\bar{X} = 0.62$ );  $IF/IAN = 0.70$  to  $0.78$  ( $\bar{X} = 0.73$ );  $IG/IP = 0.55$  to  $0.63$  ( $\bar{X} = 0.59$ ). Interanal seam present and complete. Plastron yellow or orange, with black pigment covering most of each plastral scute (Fig. 1), although at least the margins of each scute marked with yellow; bridge marked with a longitudinal black stripe, primarily on the pectoral and abdominal scutes.

Head narrow; upper jaw not hooked; very small tubercles present dorsal to angle of jaw and anterior to tympanum. Dorsum uniform yellow to olive green. Dorsolateral head region with black-bordered longitudinal yellow to olive-green blotch, interrupted posteriorly, but continuing on neck to its base as a separate narrow black-bordered stripe; blotch may be divided in two distinct ocelli (single female; Fig. 1B, C), hourglass shaped (single juvenile female), or unconstricted (single adult male). Side of head with similar black-bordered longitudinal blotch immediately behind eye, continuous with anterior portion of dorsolateral blotch in juvenile and male. Dorsum of neck dark brown to black, with medial dark black-bordered salmon to orange stripe. Chin and tomia unmarked yellow; bottom of neck yellow anteriorly and orange or

Table 1.—Extended.

IP/MCW	GW/GL
0.328	1.893
0.335 (0.32–0.35)	1.378 (1.27–1.49)
0.238 (0.20–0.27)	2.191 (1.70–2.55)
0.281 (0.26–0.31)	2.269 (1.99–2.42)
0.212 (0.18–0.24)	2.417 (2.05–3.02)
0.219 (0.20–0.23)	2.286 (1.88–2.75)

salmon posteriorly, with vague black mottling. Triturating surfaces narrow and unridged.

Anterior surface of antebrachium covered with large, imbricate scales, the largest three or four of which are sickle-shaped; largest scales on hindlimb at heel, but much smaller than largest forelimb scales. Upper parts of limbs and tail finely scaled. Exposed parts of limbs dark olive green laterally, but immaculate orange or salmon ventrally; bottom of hindfeet also salmon to orange. Recessed areas of skin salmon to orange. Tail salmon ventrally, and dark olive brown dorsally, with a vague lighter dorsolateral line on each side. Male with larger, thicker tail than females; vent at level of carapace margin in male, anterior to it in females.

*Etymology.*—In reference to the lack of black “pupils” in the eye-like markings on its neck, we name this distinctive species *Sacalia pseudocellata*. The unusual mixture of Greek (*pseudo* for false) and Latin (*ocellata* for eyed) symbolizes the unusual combination of Chinese and American trade activities that have brought this new species to light.

*Other material.*—One juvenile female (topotypic) alive in the collection of William P. McCord (WPM); to be deposited on death in the UF collection.

*Distribution.*—Known only from the type locality.

*Comparison with congeners.*—Representative specimens (see Specimens examined)

of *Sacalia bealei* and *S. quadriocellata* from public and private collections were measured (by JBI) and compared following the method of McCord & Iverson (1991). Discriminant function analysis (Fig. 2) of 13 character ratios (MCW/CL, CH/CL, MPL/CL, PW1/CL, PW3/CL, PW4/CL, GW/CL, MGL/CL, IH/CL, IP/CL, IAB/CL, IF/CL, and IAN/CL) revealed that *S. pseudocellata*, *S. bealei*, and *S. quadriocellata* are each morphometrically distinct. Specifically, *S. pseudocellata* is distinguished by its slightly wider carapace, its much larger plastron (both longer and with wider fore- and hindlobes), its longer and narrower gular scutes, and its slightly shorter interfemoral seam. That analysis also revealed several character ratios useful in discriminating among the three taxa (Table 1, Fig. 3).

*Other taxonomic conclusions.*—The discriminant function analysis also demonstrated conclusively that the syntypes of *Cistuda bealei* Gray are morphometrically identical to specimens from the Chinese mainland from Fujian and eastern Guangdong Provinces, China and from Hong Kong. A restriction of the type locality of *Sacalia bealei* to the Fuzhou region in Fujian Province, China (see also Pope 1929) seems justified, since *S. quadriocellata* apparently ranges from western Guangdong and eastern Guangxi provinces (Pope 1935) and Hainan Island (Schmidt 1927) westward to Vietnam (Siebenrock 1903) and Laos (Shiu, pers. comm.).

The discriminant function analysis also demonstrated that *S. bealei* and *S. quadriocellata* are distinct morphometrically, but bivariate plots of diagnostic characters revealed overlap in individual mensural characters (e.g., Fig. 3). However, of over 50 wildlife trade specimens of the two taxa that we have seen, none was intermediate in head color pattern (Fig. 1E–H). *Sacalia bealei* can be consistently distinguished from *S. quadriocellata* by the presence of black flecks on

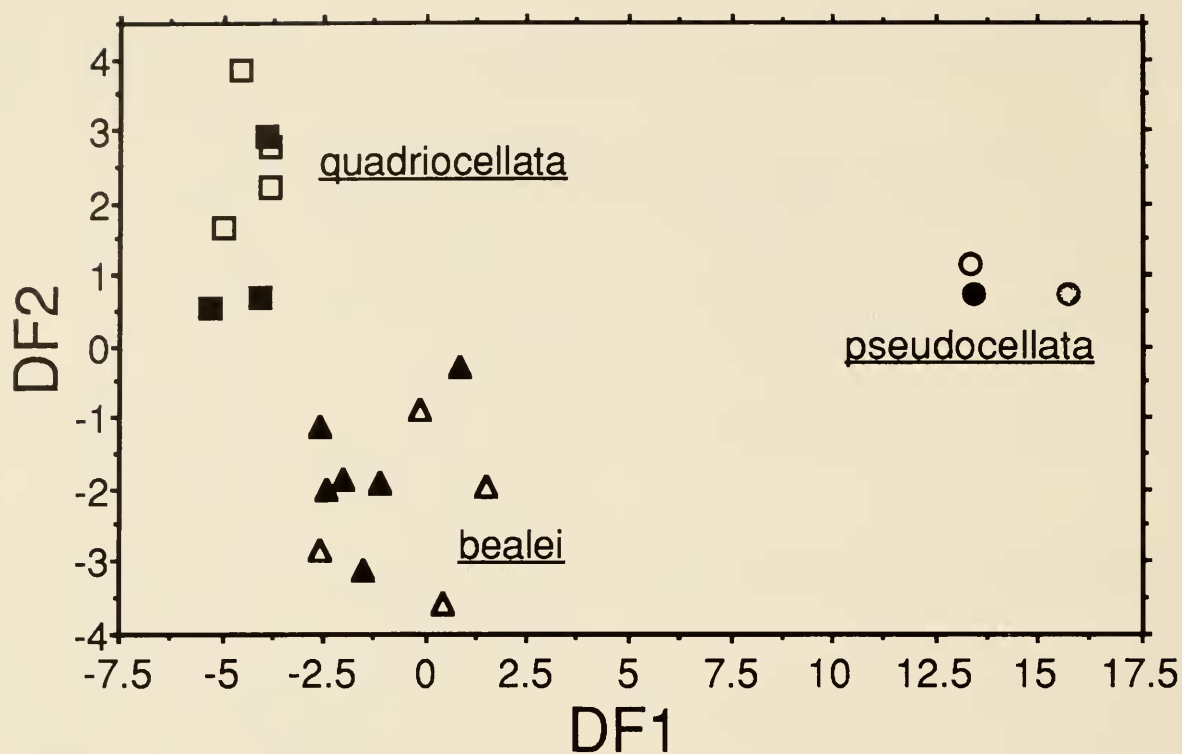


Fig. 2. Discriminant plot of combined analysis of male (solid symbols) and female (open symbols) *Sacalia* based on 13 characters (see text). First axis accounts for 91.4% of variation; second, 8.6%. Circles are *Sacalia pseudocellata*; triangles, *S. bealei*; and squares, *S. quadriocellata*.

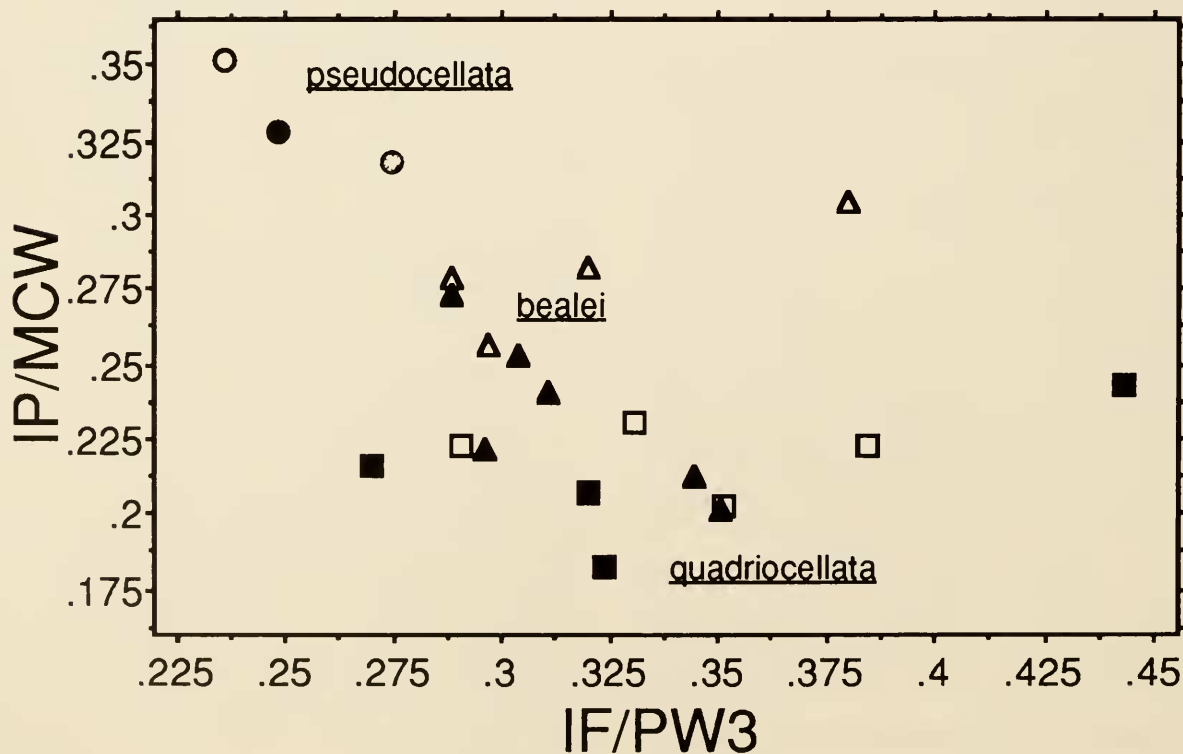


Fig. 3. Bivariate plot of the relationships among species of the genus *Sacalia* based on the characters IF/PW3 (interfemoral seam length/anterior width of plastral hindlobe) and IP/MCW (interpectoral seam length/maximum carapace width). Open symbols are females; solid, males. Species coded as in Fig. 2.

the anterior dorsum of the head of the former and the uniform unflecked dorsum in the latter (see also Pope 1935, and Fu & Zhao 1990). In addition, *S. quadriocellata* has four obvious ocelli on the posterior dorsum of the head, whereas *S. bealei* nearly always has much less obvious ocelli, with the posterior pair more obvious than the anterior pair (Fig. 1G, H). Thus, our data support Fu & Zhao (1990) in recognizing *S. bealei* and *S. quadriocellata* as separate species.

*Specimens examined.*—(See Acknowledgments for abbreviations) *S. pseudocellata*: China, Hainan Island (UF 81505–06; WMP 1, alive). *S. bealei*: China, mainland (AMNH 35179, 103735; BMNH 1947.3.4.33 and 1947.3.4.42; MCZ 58086 [formerly AMNH 34198]; MVZ 23936; UF uncat.; WPM 1–8 alive). *S. quadriocellata*: China, mainland (UF uncat.; WPM 1–8, alive); China, Hainan Island (AMNH 28337, 28339, 28341); and Laos (WPM 1–2 alive).

Key to the Genus *Sacalia*

- 1a. Blotches on dorsolateral aspect of head without distinct black “pupils”; plastron mostly black; carapace weakly tricarinate; interhumeral seam less than 45% of interpectoral seam length; interfemoral seam less than 28% of anterior width of plastral hindlobe . . . . . *S. pseudocellata*
- b. Ocelli on dorsolateral aspect of head with distinct black “pupils”; plastron with small black blotches, streaks, or vermiculations; carapace unicarinate; interhumeral seam greater than 45% of interpectoral seam length; interfemoral seam greater than 28% of anterior width of plastral hindlobe . . . . . 2
- 2a. Anterior dorsum of head finely spotted with black; anterior pair of ocelli on head much less obvious than posterior pair; interpectoral

- seam usually greater than 25% of maximum carapace width . . . *S. bealei*
- b. Dorsum of head uniform in color, unmarked with black; anterior pair of ocelli on head nearly or as obvious as posterior pair; interpectoral seam usually less than 25% of maximum carapace width . . . . . *S. quadriocellata*

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Literature Cited

Bourret, R. 1941. Les tortues de l’Indochine.—Institut Océanographique de l’Indochine 38:1–235.  
 Buskirk, J. R. 1989. New locality records for Chinese non-marine chelonians.—Chinese Herpetological Research 2(2):65–68.  
 Fu, J., & E. Zhao. 1989. The validity of *Sacalia quadriocellata*.—Asiatic Herpetological Research 3: 120–132.  
 Gray, J. E. 1831. Synopsis reptilium. I. Cataphracta, tortoises, crocodiles, and enaliosaurians. Treuttel, Wurz & Co., London, 85 pp.  
 ———. 1870. Supplement to the catalogue of shield reptiles in the collection of the British Museum. Part I. Testudinata (tortoises). Taylor and Francis, London, 120 pp.  
 Iverson, J. B. 1992. A revised checklist with distribution maps of the turtles of the world. Iverson Publishing, Richmond, Indiana, 363 pp.  
 McCord, W. P., & J. B. Iverson. 1991. A new box turtle of the genus *Cuora* (Testudines: Emydi-

- dae) with taxonomic notes and a key to the species.—*Herpetologica* 47:405–418.
- McDowell, S. B. 1964. Partition of the genus *Clemmys* and related problems in the taxonomy of the aquatic Testudinidae.—*Proceedings of the Zoological Society of London* 143:239–279.
- Merkle, D. A. 1975. A taxonomic analysis of the *Clemmys* complex (Reptilia: Testudines) utilizing starch gel electrophoresis.—*Herpetologica* 31:162–166.
- Pope, C. H. 1929. Notes on reptiles from Fukien and other Chinese provinces.—*Bulletin of the American Museum of Natural History* 58:335–487.
- . 1935. The reptiles of China. Turtles, crocodilians, snakes, lizards. Natural history of central Asia. Vol. X. American Museum of Natural History, New York, 604 pp.
- Rödel, M.-O. 1985. Zum Verhalten von *Sacalia bealei* (Gray 1831).—*Salamandra* 21(2/3):123–131.
- , & G. Praedicow. 1988. Die Chinesische Vi-  
eraugenschildkröte, *Sacalia bealei* (Gray 1831).—*Sauria* 10(4):3–8.
- Sachsse, W. 1975. *Chinemys reevesi* var. *unicolor* und *Clemmys bealei* var. *quadriocellata*—Ausprägungen von Sexualdimorphismus der beiden “Nominatformen” (Testudines, Emydidae).—*Salamandra* 11(1):20–26.
- Schmidt, K. P. 1927. The reptiles of Hainan.—*Bulletin of the American Museum of Natural History* 54:395–465.
- Siebenrock, F. 1903. Schildkröten des östlichen Hinterindiens.—*Sitzungsberichte der Akademie der Wissenschaften in Wien, Mathematisch-Naturwissenschaftliche Klasse* 112(1):333–352.
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